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(71)Applicant : MATSUSHITA ELECTRIC WORKS LTD

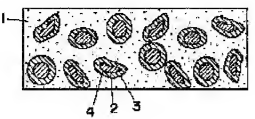
(72)Inventor : KOMORI KIYOTAKA
YAMAKAWA SEISHIRO

(54) COMPOSITE FOR ELECTROMAGNETIC SHIELD AND MANUFACTURE THEREOF

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an electromagnetic shield composite having a light wt. and high electromagnetic shield performance.

SOLUTION: A resin composite has a sea-island structure contg. a conductive filler having a conductivity of 10-2 S.cm-1 or more by 10-80 wt.%, the filler existing over 70% at the boundary 3 between a resin phase forming sea parts 1 and resin phase forming island parts 2. Thus the high-conductivity filler layer suited to enhance the electromagnetic shield effect concentrates at the boundary 3 to provide such a structure that the filler elements around the island parts 2 continuously couple with each other, without being obstructed by the low conductivity resin phase.



DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to a complex for electromagnetic shielding which combined lightweight nature and electromagnetic shielding nature, and a manufacturing method for the same.

[0002]

[Description of the Prior Art]A highly informative society is greeted in recent years, and the obstacle by the unnecessary electric wave between electronic equipment is posing a problem in connection with electronic equipment having come to overflow. It is mentioned as a factor that this is becoming structure with electronic equipment weak to electromagnetic wave disorder itself by the miniaturization of an electronic circuit or minimization of actuating current etc. The demand of portable information devices, such as a notebook computer and a cellular phone, is also becoming large, and the weight saving of apparatus is also becoming big SUBJECT. From these situations, research and development of the material which combines lightweight nature and electromagnetic shielding nature were done briskly, and the method of forming a metal membrane in the housing made from the method of shielding with a metaled housing or thermoplastics by plating, vacuum evaporation, etc., the method of sticking a metallic foil on a housing, etc. were in use.

[0003]The thermoplastics which distributed conductive fibers, such as carbon fiber and a metal fiber, for the purpose of a weight saving and low-cost-izing is developed, and it is becoming possible to make electromagnetic shielding nature provide without processes, such as plating and vacuum evaporation, in recent years.Among these, if priority is given to electromagnetic shielding nature, a conductive high metal fiber is advantageous, but if lightweight nature is taken into consideration, carbon fiber with small specific gravity is advantageous.

[0004]

[Problem(s) to be Solved by the Invention]However, if it carries out from a viewpoint of obtaining the material which combines lightweight nature and high electromagnetic shielding nature, any method of the above is still insufficient. This invention is made in view of the above-mentioned point, and it aims at providing a complex for electromagnetic shielding which combines lightweight nature and high electromagnetic shielding nature, and a manufacturing method for the same.

[0005]

[Means for Solving the Problem]The complex for electromagnetic shielding of this invention according to claim 1, a conductive filler which has the conductivity more than 10^{-2}S-cm^{-1} -- 10 - 80wt% -- a resin complex which has the sea island structure to contain is comprised, and not less than 70% of conductive fillers exist in the boundary region 3 of a resin phase which constitutes Kaifu 1, and a resin phase which constitutes the pars insularis 2

[0006]In addition to composition of claim 1, the complex for electromagnetic shielding of this invention according to claim 2 is characterized by more than 80wt% of a conductive filler being carbon. In addition to claim 1 or composition of 2, the complex for electromagnetic shielding of this invention according to claim 3 is characterized by aspect ratios of a conductive filler being 50-3000.

[0007]the complex for electromagnetic shielding of this invention according to claim 4 -- one composition of claims 1 thru/or 3 -- in addition, it is characterized by surface energy between a resin phase which constitutes Kaifu 1, and a resin phase which constitutes the pars insularis 2 being 3 or more dyne/cm. The complex for electromagnetic shielding of this invention according to claim 5, claim 1 or composition of 4 -- in addition, it is characterized by a difference of surface energy between a resin phase and a conductive filler which constitute Kaifu 1, and surface energy between a resin phase and a conductive filler which constitute the pars insularis 2 being 3 or less dyne/cm.

[0008]A manufacturing method of the complex for electromagnetic shielding of this invention according to claim 6, In manufacturing the complex for electromagnetic shielding according to any one of claims 1 to 5, a process of kneading together a conductive filler which has the conductivity more than two kinds of resin which forms sea island structure, and 10^{-2}S-cm^{-1} is included.

[0009]

[Embodiment of the Invention]Hereafter, an embodiment of the invention is described. The mimetic diagram showing the example of the structure of the complex for electromagnetic shielding of this invention is shown in drawing 1. As shown in drawing 1, the resin complex which comprises two kinds of resin forms sea island structure, and the complex for electromagnetic shielding of this invention has structure which the conductive filler concentrated on the boundary region 3 of Kaifu 1 and the pars insularis 2. This structure is

Polymer Preprints and Japana Vol.38 No.2(1989)P.4433-4435, and is reported as fundamental study about conductivity. As it is indicated in drawing 2 as the boundary region 3, the distance from the boundary line 4 of the pars insularis 2 is a field of the range to 1/4 of the sum of the longest diameter a of the pars insularis 2, and the shortest diameter b of the pars insularis 2 here.

[0010]In the thing which thermoplastics was made to distribute, conductive fibers, such as carbon fiber and a metal fiber, like the conventional complex for electromagnetic shielding. Since the conductive fiber is distributed almost uniformly by thermoplastics, in order to give good electromagnetic shielding nature to the complex for electromagnetic shielding, Thermoplastics is made to distribute a lot of conductive fibers, the relation between conductive fibers is secured, and if it is ******, the specific gravity of **, therefore the complex for electromagnetic shielding becomes high. When the quantity of the conductive fiber was reduced for the weight saving of the complex for electromagnetic shielding, it was difficult for the relation between conductive fibers to be obstructed by conductive low thermoplastics, and to give good electromagnetic shielding nature to the complex for electromagnetic shielding.

[0011]However, when the layer of a conductive filler suitable for heightening the electromagnetic shielding effect with high conductivity concentrates the complex for electromagnetic shielding of this invention on the boundary region 3, It becomes the structure connected continuously, without the conductive fillers which exist in the circumference of the pars insularis 2 being barred by the resin phase with low conductivity, and electromagnetic shielding nature becomes high. When the conductive filler has led to the circumference of the pars insularis 2 at the coiled form, magnetism can be negated according to electromagnetic induction phenomena, and electromagnetic shielding nature can be improved effectively. Since high electromagnetic shielding nature can be obtained with the small amount of conductive fillers as compared with the conventional thing, the quantity of a conductive filler can be stopped and the weight saving of the complex for electromagnetic shielding can be carried out. Therefore, the complex for electromagnetic shielding of this invention can secure the outstanding characteristic which has lightweight nature and high electromagnetic shielding nature.

[0012]the conductive filler which has the conductivity more than 10^{-2}S-cm^{-1} in the resin complex which changes from two kinds of resin to the complex for electromagnetic shielding of this invention in order to demonstrate the above characteristics effectively -- 10 - 80wt% of the complex whole quantity for electromagnetic shielding -- it is made to contain If there is nothing, electromagnetic shielding nature will become insufficient, there is a possibility that the conductive filler saw to 10wt% here and that a void may occur in a Plastic solid if 80wt% is exceeded, and it is not desirable. If the conductive filler which it is made for not less than 70% of thing of the conductive filler whole quantity in the complex for electromagnetic shielding to

exist in the boundary region 3 of Kaifu 1 and the pars insularis 2, and exists in the boundary region 3 is not filled to 70%, It becomes difficult to acquire the efficient electromagnetic shielding effect to the content of a conductive filler.

[0013]As two kinds of resin which forms this sea island structure, Although it does not limit in particular, for example as a housing material, With high intensity, the material of low specific gravity has it and as such a material, [preferred] Polystyrene, syndiotactic polystyrene, polyethylene, polypropylene, A polymethylpentene, cyclic polyolefin (the Nippon Zeon make, trade name "ZEONEX", etc.), ABS plastics, an AS resin, AAS resin, AES resin, ACS resin, polymethylmethacrylate, diallyl phthalate resin, polybutylene naphthalate, polyethylene terephthalate, polybutylene terephthalate, Nylon 66, nylon 6, Nylon 12, Nylon 612, Nylon 46, polyamide, polyphthalamide, polyacetal, Polycarbonate, polysulfone, polyether sulphone, a polyphenylene sulfide, Polyarylate, a polyether ether ketone, all the aroma group polyester, Polyamidoimide, polyimide, polyether imide, polyamino bismaleimide, BT resin, a liquid crystal polymer, polyketone, polyphenylene oxide, a fluoro-resin, an epoxy resin, etc. are independent, or compound resin is mentioned. When choosing from these resin two kinds of resin which forms sea island structure, It is preferred that the surface energy between resin chooses what is 3 or more dyne/cm, and if such resin is chosen, when the third component infiltrates into the boundary region 3 and decreases the interface, it will become a more stable structure for the high surface energy between two resin. That is, a conductive filler exists in the boundary region 3 of Kaifu 1 and the pars insularis 2 easily intensively. Glass fiber, an aramid fiber, polyester liquid crystal textiles, etc. may be added as a reinforcing member to these resin, or fire retardant may be added in order to give fire retardancy.

[0014]As the above-mentioned conductive filler, especially if conductivity is more than 10^{-2}S-cm^{-1}, it does not limit, but carbon, copper, iron, nickel, cobalt, gold, platinum, zinc, tin, etc. can be illustrated, and a kind independent or two or more sorts of composites can be used for these. since [among these,] specific gravity of carbon is small as compared with metal -- carbon -- more than 80wt% -- when the included composite is used as a conductive filler, the weight saving of the complex for electromagnetic shielding can be carried out, and it is desirable. Here, since only carbon can also be used as a conductive filler, the maximum of a carbonaceous rate is 100wt%. Although it may not be limited, and may be spherical or may be fibrous, especially the shape of a conductive filler can raise electromagnetic shielding nature further as aspect ratios are 50-3000, and is preferred. Although that reason is not clear, it is presumed that it is because a conductive filler becomes a coiled form easilier in this range.

[0015]The surface energy between resin and the conductive filler which constitute Kaifu 1, When resin and a conductive filler are chosen so that a difference with the surface energy between resin and the conductive filler which constitute the pars insularis 2 may be 3 or less dyne/cm, a conductive filler exists in the boundary region 3 of Kaifu 1 and the pars insularis 2

easily intensively, and is preferred. If the difference of this surface energy exceeds 3 dyne/cm here, it will become easy to distribute a conductive filler to resin with the smaller surface energy between conductive fillers selectively.

[0016]As mentioned above, the surface energy between resin and the conductive filler which the surface energy between resin chooses what is 3 or more dyne/cm as two kinds of resin which forms sea island structure, and constitute Kaifu 1, By choosing resin and a conductive filler so that a difference with the surface energy between resin and the conductive filler which constitute the pars insularis 2 may be 3 or less dyne/cm, Not less than 70% of thing of the conductive filler whole quantity in the complex for electromagnetic shielding can exist in the boundary region 3 of Kaifu 1 and the pars insularis 2, and can acquire the efficient electromagnetic shielding effect to the content of a conductive filler.

[0017]Although the manufacturing method in particular of the above complexes for electromagnetic shielding of this invention is not limited, it can illustrate the following methods. First, the conductivity which becomes stable kneads together the conductive filler more than 10^{-2}S-cm^{-1} using kneading machines, such as a 2 axis kneading machine, by the material pellet of two kinds of resin which forms sea island structure, and the interface of sea island structure.

[0018]The material kneaded together can be fabricated by extrusion molding, and after obtaining a granular pellet by cutting pulling out to a line, it can also fabricate by injection molding. Before kneading a raw material here, it is preferred to perform a surface treatment to a conductive filler so that it may become stable by the interface of sea island structure. Especially as this disposal method, although it does not limit, independent processing or compound processing of an anode oxidation method, a plasma treatment method, a frame process method, a corona discharge method, a coupling agent approach, a resin coat method, etc. can be performed.

[0019]

[Example]Hereafter, this invention is explained in full detail according to an example.

(Example 1) 1 kg of high density polyethylene (made by an Idemitsu petrochemical company), 1 kg of polymethylmethacrylate (made by Sumitomo Chemical Co., Ltd.), And after filling 1 kg of carbon fillers (made by a Ketchen black international company) of mean-particle-diameter [of about 30 nm], aspect ratio 1 [about], and conductivity abbreviation 10^{3}S-cm^{-1} in a plastic bag, it mixed by shaking for 10 minutes by a hand. The difference of the surface energy between two kinds of this resin is 8.6 dynes/cm here. The 2 axis kneading machine was used, this mixture was cut after kneading the speed for 50g/and cooling the scoured mixture at 200 **, and the pellet of the mixture was obtained.

[0020]By injection molding, the 150mmx150mmx2mm complex for electromagnetic shielding was obtained from the obtained pellet. 1 kg of polypropylene (example 2) (made by an

Idemitsu petrochemical company) which made 200 ** melting temperature at the time of shaping, The polymethylmethacrylate (made by Sumitomo Chemical Co., Ltd.) of 1 kg, and the mean particle diameter of about 30 nm, The complex for electromagnetic shielding was obtained by the same method as Example 1 using 1 kg of carbon fillers (made by a Ketchen black international company) of aspect ratio 1 [about] and conductivity abbreviation 10^3S-cm^{-1}. The difference of the surface energy between two kinds of this resin is 6.8 dyne/cm here.

(Example 3) The complex for electromagnetic shielding was obtained like Example 1 except the shape of a carbon filler being a fiber diameter of 13 micrometers, and about 6 mm (aspect ratio 460) of fiber length's staple fiber (made by Osaka Gas Co., Ltd.). The difference of the surface energy between two kinds of this resin is 8.6 dyne/cm here.

(Example 4) The complex for electromagnetic shielding was obtained like Example 2 except the shape of a carbon filler being a fiber diameter of 13 micrometers, and about 6 mm (aspect ratio 460) of fiber length's staple fiber (made by Osaka Gas Co., Ltd.).

(Example 5) 1 kg of polypropylene (made by an Idemitsu petrochemical company), 1 kg of polymethylmethacrylate (made by Sumitomo Chemical Co., Ltd.), And the complex for electromagnetic shielding was obtained like Example 1 using 2 kg of carbon fillers (made by a Ketchen black international company) of mean-particle-diameter [of 30 nm], aspect ratio 1 [about], and conductivity abbreviation 10 ^{3}S-cm^{-1}. The complex for electromagnetic shielding was obtained by the same method as Example 1. The difference of the surface energy between two kinds of this resin is 6.8 dyne/cm here.

(Example 6) 1 kg of polypropylene (made by an Idemitsu petrochemical company), 1 kg of polymethylmethacrylate (made by Sumitomo Chemical Co., Ltd.), And the complex for electromagnetic shielding was obtained like Example 1 using 0.5 kg of carbon fillers (made by a Ketchen black international company) of mean-particle-diameter [of 30 nm], aspect ratio 1 [about], and conductivity abbreviation 10 ^{3}S-cm^{-1}. The difference of the surface energy between two kinds of this resin is 6.8 dyne/cm here.

(Example 7) 0.5 kg of polypropylene (made by an Idemitsu petrochemical company), 1 kg of polymethylmethacrylate (made by Sumitomo Chemical Co., Ltd.), And the complex for electromagnetic shielding was obtained like Example 1 using 1 kg of carbon fillers (made by a Ketchen black international company) of mean-particle-diameter [of 30 nm], aspect ratio 1 [about], and conductivity abbreviation 10^3S-cm^{-1}. The difference of the surface energy between two kinds of this resin is 6.8 dyne/cm here.

(Comparative example 1) High density polyethylene (made by an Idemitsu petrochemical company) of 2 kg, and the mean particle diameter of 30 nm, The complex for electromagnetic shielding was obtained like Example 1 using 1 kg of carbon fillers (made by a Ketchen black international company) of aspect ratio 1 [about] and conductivity abbreviation 10^3S-cm^{-1}.

(Comparative example 2) The polymethylmethacrylate (made by Sumitomo Chemical Co., Ltd.) of 2 kg, and the mean particle diameter of 30 nm, The complex for electromagnetic shielding was obtained like Example 1 using 1 kg of carbon fillers (made by a Ketchen black international company) of aspect ratio 1 [about] and conductivity abbreviation 10^3S-cm^{-1}.
(Comparative example 3) Polypropylene (made by an Idemitsu petrochemical company) of 2 kg, and the mean particle diameter of 30 nm, The complex for electromagnetic shielding was obtained like Example 1 using 1 kg of carbon fillers (made by a Ketchen black international company) of aspect ratio 1 [about] and conductivity abbreviation 10^3S-cm^{-1}.
(Evaluation) It has checked that can check the sea island structure from which the phase of polymethylmethacrylate serves as Kaifu 1 in all in Examples 1 thru/or 7 as a result of performing SEM observation of a section, and a filler existed in the boundary region 3 of this sea island structure intensively about the thing of an example and a comparative example. On the other hand, sea island structure was not checked about the comparative examples 1 thru/or 3.
[0021]Also about electromagnetic shielding nature, it was checked that Examples 1 thru/or 7 are also higher than the thing of the comparative examples 1 thru/or 3.
[0022]
[Effect of the Invention]As mentioned above, the complex for electromagnetic shielding of this invention according to claim 1, the conductive filler which has the conductivity more than 10^{-2}S-cm^{-1} -- 10 - 80wt% -- the resin complex which has the sea island structure to contain being comprised, and, Since not less than 70% of conductive fillers exist in the boundary region of the resin phase which constitutes Kaifu, and the resin phase which constitutes the pars insularis, When the layer of a conductive filler with high conductivity concentrates on a boundary region, it becomes the structure connected continuously, without the conductive fillers which exist in the circumference of the pars insularis being barred by the resin phase with low conductivity, and electromagnetic shielding nature becomes high.
As compared with the conventional thing, high electromagnetic shielding nature can be obtained with the small amount of conductive fillers, the quantity of a conductive filler can be stopped, and the weight saving of the complex for electromagnetic shielding can be carried out.

[0023]The complex for electromagnetic shielding of this invention according to claim 2, In addition to the composition of claim 1, since more than 80wt% of the conductive filler whole quantity is carbon, with carbon with comparatively small specific gravity, the weight of the conductive filler contained in the complex for electromagnetic shielding can be reduced, and the weight saving of the complex for electromagnetic shielding can be carried out further.

[0024]In addition to claim 1 or the composition of 2, since the aspect ratios of a conductive filler are 50-3000, the complex for electromagnetic shielding of this invention according to claim 3 can raise further the electromagnetic shielding nature of the complex for electromagnetic shielding. The complex for electromagnetic shielding of this invention according to claim 4, In one composition of claims 1 thru/or 3, in addition, since the surface energy between the resin phase which constitutes Kaifu, and the resin phase which constitutes the pars insularis is 3 or more dyne/cm, When the third component decreases the interface between two kinds of resin, it becomes a more stable structure, a conductive filler exists in the boundary region of Kaifu and the pars insularis easily intensively, and the lightweight nature and electromagnetic shielding nature of the complex for electromagnetic shielding can be improved further.
[0025]The complex for electromagnetic shielding of this invention according to claim 5, In claim 1 or the composition of 4, in addition, since the difference of the surface energy between the resin phase and conductive filler which constitute Kaifu, and the surface energy between the resin phase and conductive filler which constitute the pars insularis is 3 or less dyne/cm, A conductive filler does not distribute selectively to the smaller resin phase of the surface energy between conductive fillers, A conductive filler exists in the boundary region of Kaifu and the pars insularis easily intensively, and the lightweight nature and electromagnetic shielding nature of the complex for electromagnetic shielding can be improved further.
[0026]The manufacturing method of the complex for electromagnetic shielding of this invention according to claim 6, Since the process of kneading together the conductive filler which has the conductivity more than two kinds of resin which forms sea island structure, and 10^{-2}S-cm^{-1} is included, the complex for electromagnetic shielding of this invention can be manufactured easily.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1]a conductive filler which has the conductivity more than 10^{-2}S-cm^{-1} -- 10 - 80wt% -- a resin complex which has the sea island structure to contain being comprised, and, A complex for electromagnetic shielding, wherein not less than 70% of conductive fillers exist in a boundary region of a resin phase which constitutes Kaifu, and a resin phase which constitutes pars insularis.

[Claim 2]The complex for electromagnetic shielding according to claim 1, wherein more than 80wt% of a conductive filler is carbon.

[Claim 3]The complex for electromagnetic shielding according to claim 1 or 2, wherein aspect ratios of a conductive filler are 50-3000.

[Claim 4]The complex for electromagnetic shielding according to any one of claims 1 to 3, wherein surface energy between a resin phase which constitutes Kaifu, and a resin phase which constitutes pars insularis is 3 or more dyne/cm.

[Claim 5]The complex for electromagnetic shielding according to any one of claims 1 to 4, wherein a difference of surface energy between a resin phase and a conductive filler which constitute Kaifu, and surface energy between a resin phase and a conductive filler which constitute pars insularis is 3 or less dyne/cm.

[Claim 6]A manufacturing method of a complex for electromagnetic shielding including a process of kneading together a conductive filler which has the conductivity more than two kinds of resin which forms sea island structure, and 10^{-2}S-cm^{-1} in manufacturing the complex for electromagnetic shielding according to any one of claims 1 to 5.

[Translation done.]